CLAIMS

1. A method for determining contours, preferably level contours, and primitives in a digital image, said method comprising the steps of:

- generating the gradients of the digital image;
- finding one or more local maxima of the absolute gradients;
- use the one or more local maxima as seeds for generating contours, the generation of the contours for each seed comprising determining an ordered list of points representing positions in the digital image and belonging to a contour;
- for all of said positions determining the curvature, preferably determined as $d\theta/ds$ preferably pixel units, of the contours;
- from the determined curvatures determine primitives as characteristic points on or segments of the contours.

2. A method according to claim 1 further comprising the step of eliminating potential seed points identified near already defined contours.

3. A method according to any of the claims 1-2, wherein the generation of the contours comprising assigning the list of points representing positions in the digital image, each point having a value being assigned to be common with the value of the seed.

4. A method according to any of the claims 1-2, wherein the generation of the contours comprising assigning the list of points following in each point the direction of the maximum or minimal gradient detected perpendicular to a contour direction.

5. A method according to claim 1-2, wherein the generation of the contours comprising assigning the list of points with values being above or below the value of the seed and one or more neighbour pixels with value below or above said value of the seed.

6. A method according to claim 1-5, wherein the list of pixels is established by moving through the digital image in a predetermined manner.

7. A method according to claim 2-6, wherein the contours being determined from an interpolation based on the list of pixels.

8. A method according to claim 2-7 wherein the list is an ordered list of pixels.

9. A method according to claim 1-8, wherein the gradients are determined by calculating the difference between numerical values assigned to neighbouring pixels.

10. A method according to claim 1-9, wherein the gradients are stored in an array in which each element corresponds to a specific position in the first image and being a numerical value representing the value of the gradient of the first image's tones in the specific position.

11. A method according to claim 1-10, wherein the curvatures being established as $\kappa=d\theta/ds$ where θ is the tangent direction at a point on a contour and s is the arc length measured from a reference point.

12. A method according to any of the claims 1-11, wherein the primitives comprise of one or more of the following characteristics:

- segments of straight lines,
- segments of relatively large radius circles,
- inflection points,
- points of maximum numerical value of the curvature, said points being preferably assigned to be corners,
- points separating portions of very low and very high numerical value of the curvature, and
- small area entities enclosed by a contour.

13. A method according to any of the claims 1-12, wherein each contour is searched for one or more of the following primitives:

- inflection point, being a region of or a point on the contour having values of the absolute value of the curvature being higher than a predefined level;
- concave corner, being a region of or a point on the contour having positive peaks of curvature;
- convex corner, being a region of or a point on the contour having negative peaks of curvature;
- straight segment, being segments of the contour having zero curvature;

and/or

- circular segments, being segments of the contour having constant curvature.

14. A method for recognition, such as classification and/or localisation of three dimensional objects, said one or more objects being imaged so as to provide a recognition image being a two dimensional digital image of the object, said method utilises a database in which numerical descriptors are stored for a number of training images, the numerical descriptors are the intrinsic and extrinsic properties of a feature, said method comprising:

- identifying features, being predefined sets of primitives, for the image
- extracting numerical descriptors of the features, said numerical descriptors being of the two kind:
  - extrinsic properties of the feature, such as the location and orientation of the feature in the image, and
  - intrinsic properties of the feature preferably derived after a homographic transformation being applied to the feature
- matching said properties with those stored in the database and in case a match is found assign the object corresponding to the properties matched in the database to be similar to the object of the object to be recognised.

15. A method according to claim 14, for matching a recognition image with training images stored in a database, wherein the matching comprising the following steps:

- for each training image:
- determining the values of roll, tilt and pan of the transformations bringing the features of the recognition image to be identical with the features of the training image;
- identify clusters in the parameter space defined by the values of roll, tilt and pan determined by said transformations

and

- identify clusters having predefined intensity as corresponding to an object type and localisation.

16. A method according to claim 14 or 15, wherein the database comprise for each image one or more records each representing a feature with its intrinsic properties and its extrinsic properties.

17. A method according to claim 16, wherein the matching comprises the steps of:

- resetting the roll, tilt and pan parameter space,
- for each feature in the recognition image, matching properties of the recognition image with the properties stored in the database,
- in case of match: determining roll, tilt, and pan based on the extrinsic properties from the database and from the recognition image,
- updating the parameter space, and
- test for clustering and store coordinates of clusters with sufficiently high density/population with an index of the training image,
- repeating the steps until all features in the recognition image have been matched.

18. A method according to claim 17 wherein the determination of the roll, tilt and pan are only done for features having similar or identical intrinsic properties compared to the intrinsic properties in the database.

19. A method according to claim 17 wherein the matching comprises comparing the intrinsic descriptors of the recognition image with the intrinsic descriptors stored in the database thereby selecting matching features.

20. A method according to claim 14 or 19, wherein said database is generated according to any of the claims 21-14.

21. A method of generating a database useful in connection with localising and/or classifying a three dimensional object, said object being imaged so as to provide a two dimensional digital image of the object,
said method utilises the method according to any of the claims 1-20 for determining primitives in the two dimensional digital image of the object, said method comprising:

- identifying features, being predefined sets of primitives, in a number of digital images of one or more object, the images represent different localisations of the one or more object;
- extracting and storing in the database, numerical descriptors of the features, said numerical descriptors being of the two kind:
- extrinsic properties of the feature, that is the location and orientation of the feature in the image, and
- intrinsic properties of the feature being derived after a homographic transformation being applied to the feature.

22. A method according to any of the claims 14-21, wherein the extrinsic properties comprises a reference point and a reference direction.

23. A method according to any of the claims 14-22, wherein the intrinsic properties comprises numerical quantities of features.

24. A method according to any of the claims 14-20 wherein the object being imaged by at least two imaging devices thereby generating at least two recognition images of the object and wherein the method according to any of the claims 12-18 are applied to each recognition image and wherein the match found for each recognition image are compared.

25. A method according to claim 24, where the method comprising the steps of:

- for each imaging device, providing an estimate for the three dimensional reference point of the object,
- for each imaging device, calculating a line from the imaging device pinhole to the estimated reference point,

and when at least two or more lines have been provided,

- discarding the estimates in the case that the said two or more lines do not essentially intersect in three dimensions,

and when the said two or more lines essentially intersect,

- estimating a global position of the reference point based on the pseudo intersection between the lines obtained from each imaging device.